Optimal Object Categorization Under Application Specific Conditions

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State-of-the-art object categorization algorithms try to aim at a robust object detection of a specific object class while coping with an enormous variation of the object class and the scene. Examples of these variations are the possible lighting conditions, occlusions of other objects, orientation and location of the objects itself inside the camera image, influence of background clutter and of course intra-class variation (size, shape, color and texture) of the object class that needs to be detected. However, industrial computer vision applications have much less variation by applying strict conditioning of parameters, like a very controlled lighting, compared to test cases in academic context.

Classic object categorization doesnt use this extra knowledge and assumes every kind of variation can actually happen. In a new universal object categorization framework, we want to exploit this object and scene variation of the application, to reach faster and more accurate algorithms with a high detection rate. Since object detection only becomes interesting for the largest part of the industry when reaching detection rates of 99.9%, we need to increase current performance of object categorization techniques. Lower detection rates will have a large economic impact for the company, since a significant part of the objects is ignored, leading to the fact that current state-of-the-art object categorization algorithms havent been used in industrial computer vision applications.

With our universal framework, the object and scene variation contained in the training data will actually be used and will lead to better results for these specific industrial applications. During the PhD we want the aim for three goals, making sure the industry gets convinced of the possibilities of this family of object detection techniques.

1. We aim for a higher detection rate. Classic techniques reach an in the wild detection rate of 85% but for industrial applications a rate of 99.9% or higher is expected. By integrating the known scene and object variation into the algorithm, we are convinced that we can reach these high demands. This will ensure that the industry will actually use these techniques. We will mainly try to incorporate all scene and object variations into possible feature channels in a smart way for integration into the proposed universal object categorization framework.

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2. We aim for a minimal manual input. Classic techniques demand many thousands of manual annotations during the gathering of training images. We aim at reducing the manual annotations to several hundreds of images by using an innovative active learning strategy. A manual annotator will iteratively annotate a small set of images, resulting in a basic model which will then decide which other examples will raise the detector to a higher detection rate.
3. We aim for faster algorithms. Due to the many processing steps, classic object categorization algorithms are very time and memory consuming. Adding extra functionality for our framework will only increase this. Nevertheless we want to optimize our framework by applying CPU and GPU optimizations, in order to ensure real time performance of the resulting detector. We will also ensure that the resulting training time for a single model will be drastically reduced.